

Remarks/Arguments:

Claims 11, 12, 18 and 20-24 are pending.

Claims 11, 20, 23 and 24 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Graham (U.S. Patent No. 5,200,679) in view of Daly (U.S. Patent No. 4,605,354). Claims 12 and 21 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Graham in view of Daly and further in view of Andeen et al. (U.S. Patent No. 4,637,736) or Hill et al. (U.S. Patent No. 3,904,234). Claims 18 and 22 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Graham in view of Daly and further in view of Chao et al. (U.S. Patent No. 5,847,529) or Hollbrooks (U.S. Patent No. 6,692,049). Reconsideration is respectfully requested for the reasons set forth below.

Claim 11 includes features neither disclosed nor suggested by the cited art, namely:

- a) determining a direction of an external force acting upon an object, the external force exclusive of a grasp force by a robot grasping the object;
- b) determining, when a change in the external force in said direction is equal to or greater than a predetermined threshold, if the change in the external force in said direction is i) caused by a person taking away the object and due to a first condition which is a delivery of the grasped object or ii) caused by a force resulting from an other cause and due to a second condition which is a non-delivery of the grasped object (Emphasis Added)

Claim 20 includes a similar recitation. Claims 11 and 20 relate to a robot arm for grasping an object. The robot arm determines a direction (i.e., an orientation) of an external force acting upon a grasped object, where the external force is exclusive of a grasp force provided by the robot arm that grasps the object. When an external force applied to the grasped object is detected by the robot arm, the direction (i.e.,

the orientation of this force is determined). After determining the direction (i.e., the orientation of the external force), it is determined whether the force is a grasping force. If the force is determined to be a grasping force, the object is delivered. If the force is determined not to be a grasping force, the object is not delivered.

As shown in Fig. 2 and described in the subject specification at page 8, line 25 - page 11, line 7, there are two force vectors applied to the object that is grasped by the robot hand. A first vector f_s is the detected force (detected by a force sensor) applied by the object to the robot hand (which is grasping the object with a grasp force). A second force vector f_h represents an external force that is applied to the object. This force vector f_h is different and separate from the detected force vector f_s . Examples of the external force that acts upon the object include: 1) a force acting on the object by a human receiving the object, 2) a force acting on the object if the robot arm hits an obstacle (such as during a movement) and 3) a force acting on the object by gravity.

As shown in Fig. 2 of the subject specification and as known to the skilled person, a vector includes a magnitude and an orientation. Thus, the present invention determines a direction (i.e., an orientation) of an external force that is separate from the grasp force of the object gripped by the robot hand and which is an additional force acting on the object grasped by the robot hand.

Graham discloses, in Figs. 1-3, an artificial hand 11, including sensing pad 72 provided on finger 14. Graham discloses, in Figs. 5 and 6 a cylinder 71 that is grasped between sensing pad 72 and phalanx 17. A greater tensile force is applied until a compressive force detected by sensing pad 72 reaches a predetermined level so that an object is grasped by artificial hand 11 (col. 7, lines 40-65). Graham also describes releasing cylinder 71 from artificial hand 11 (col. 7, lines 66 - col. 8, line 8). Thus,

Graham teaches measuring a compressive force exerted on the grasped object by the artificial hand and that the artificial hand is able to increase its tensile force or release the object.

Graham does not disclose or suggest Applicants' claimed features of determining a direction of an external force acting upon an object where the external force is exclusive of a grasp force by a robot grasping the object, as recited by claims 11 and 20 (emphasis added). These features are neither disclosed nor suggested by Graham. Although Graham describes detecting a compressive force exerted on the object by the artificial hand, Graham is silent on determining a direction (i.e., an orientation) of an external force acting on the object (e.g., a human receiving the object) that is exclusive of a grasp force by a robot grasping the object.

As acknowledged by the Examiner, Graham does not disclose or suggest Applicants' claimed features of determining if a change in the external force in the direction is caused by a force resulting from another cause and due to a non-delivery of the grasped object, as recited by claims 11 and 20. Indeed, Graham is silent on determining a direction of an external force (i.e., an external force acting on the object which is different from the force acting on the object by the grasp force) in order to determine whether the external force is caused by a person taking away the grasped object or by a force resulting from another cause on the grasped object. Thus, Graham does not include all of the features of claims 11 and 20.

Daly discloses, in Figs. 1 and 2, a slip-sensing gripper system that includes springback accelerometer 1 and ambient accelerometer 2 to determine the slip of an object in a robot gripper (col. 2, line 61 - col. 3, line 25). Daly does not make up for the deficiencies of Graham because they do not disclose or suggest determining a direction of an external force acting upon an object, where the external force is

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exclusive of a grasp force by a robot grasping the object, as required by claims 11 and 20. These features are neither disclosed nor suggested by Daly. Accordingly, allowance of claims 11 and 20 is respectfully requested.

Claims 12, 18 and 21-24 include all of the features of respective claims 11 and 20 from which they depend. The remaining cited art do not make up for the deficiencies of Graham and Daly because these references, either alone or in combination, do not disclose or suggest: 1) determining a direction of an external force that is exclusive of a grasp force by a robot grasping the object and 2) whether a change in the external force is caused by a person taking away the object or by a force resulting from an other cause. Accordingly, claims 12, 18 and 21-24 are also patentable over the cited art.

In view of the remarks set forth above, the above-identified application is in condition for allowance, which action is respectfully requested.

Respectfully submitted,

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